

CLAIMS

1. A universal joint comprising a cross spider, comprising:

a trunnion provided in the cross spider;

a plurality of needle rollers arranged in an annular shape so as to surround an outer peripheral surface of the trunnion; and

an outer ring held in a fitting hole of a yoke and supporting the trunnion so as to be rotatable with the needle rollers sandwiched therebetween,

the outer ring comprising a cylindrical main body fitted in the fitting hole of the yoke and a closed end for closing one end of the main body,

the trunnion comprising an end surface having a ball holding hole formed thereon,

a ball being held in the ball holding hole,

a ball receiving section for elastically receiving the ball held in the ball holding hole being provided at the closed end of the outer ring,

the ball receiving section comprising either one of a conical tapered surface and a concavely-curved surface, and

a radius of curvature of the concavely-curved surface being larger than a radius of the ball.

2. The universal joint according to claim 1, wherein a difference between an inner diameter of the outer ring and an outer diameter of the trunnion is larger than two times a diameter of the needle roller.

3. The universal joint according to claim 1, wherein

a transmitted torque between the trunnion and the yoke is transmitted between the trunnion and the yoke through the ball when the transmitted torque is lower than a predetermined amount, and

the transmitted torque between the trunnion and the yoke is transmitted between the trunnion and the yoke through the needle rollers when the transmitted torque exceeds the predetermined amount.

4. The universal joint according to claim 1, wherein the closed end of the outer ring is elastically deformable.

5. The universal joint according to claim 1, wherein

the ball holding hole comprises a circular hole arranged coaxially with the trunnion, and the ball is pressed into the circular hole.

6. The universal joint according to claim

5, wherein

the ball holding hole comprises a circular hole arranged coaxially with the trunnion, and the ball is accommodated so as to be slidable in the circular hole.

7. The universal joint according to claim 6, further comprising an urging member accommodated in the circular hole and urging the ball to the ball receiving section.

8. The universal joint according to claim 7, wherein the urging member has a projection for preventing the ball from slipping off the circular hole.

9. The universal joint according to claim 7, wherein the urging member comprises an elastic member.

10. The universal joint according to claim 7, wherein the urging member comprises a helical compression spring.

11. The universal joint according to claim 7, wherein the urging member comprises a leaf spring.

12. The universal joint according to claim 7, wherein the urging member includes a belleville spring.

13. The universal joint according to claim 12, wherein the belleville spring includes a belleville spring having a conical tapered surface receiving the ball.

14. The universal joint according to claim 7, wherein the urging member comprises a supporting section held in the circular hole and a belleville spring extended from the supporting section.

15. The universal joint according to claim 14, wherein

the supporting section comprises a base composed of an annular plate received by a bottom of the circular hole, and

the belleville spring includes a belleville spring extended so as to spread in a conical tapered shape from an inner peripheral edge of the base.

16. The universal joint according to claim 14, wherein

the supporting section includes a supporting section having a cylinder fitted in the circular hole, and

the belleville spring includes a belleville spring whose diameter is reduced in a conical

tapered shape from one end of the cylinder to the bottom of the circular hole.

17. The universal joint according to claim 7, wherein

the urging member comprises a cylinder fitted in the circular hole and held in the circular hole and a ball urging projection provided in the cylinder and projecting inward in a radial direction of the cylinder, and

the ball urging projection elastically urges the ball in an axial direction and a radial direction of the trunnion.

18. The universal joint according to claim 17, further comprising a ball slip preventing projection provided at one end of the cylinder for preventing the ball from slipping off the circular hole.

19. The universal joint according to claim 18, wherein the ball is held in the cylinder between the ball urging projection and the ball slip preventing projection.